

**Original citation:**

Miller, Marcus and Zhang, Lei. (2015) The hedgehog and the fox : from DSGE to Macro-Pru. The Manchester School, 83 . pp. 31-55.

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<http://dx.doi.org/10.1111/manc.12119>

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# **The Hedgehog and the Fox: from DSGE to Macro-Pru<sup>1</sup>**

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April 2015

Abstract

Prior to the financial crisis of 2008/9, DSGE models-without-money set a new standard in applied macroeconomics; and they were widely adopted by Central Banks to help achieve their inflation targets.

Controlling inflation did not deliver financial stability, however: far from it. What about the role of externalities? We examine, in particular, how steps to mitigate microeconomic principal/agent problems can create macroeconomic externalities -- ‘financial accelerators’ that affect balance sheets in pro-cyclical fashion.

The appeal of macro-models based on ‘efficient financial markets’ surely contributed to over-confidence before the crisis. Now is the time, we argue, to embrace a wider perspective.

(99 words)

[Forthcoming in *The Manchester School* ]

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<sup>1</sup> The benefit of discussions with Ken Binmore, Oliver Bush, Neil Ericsson, Peter Hammond, Sheri Markose, Herakles Polemarchakis, Neil Rankin and Guilio Trigilia, and of comments received at the Manchester Conference of the CGBCR in July 2014, is gratefully acknowledged, though we remain responsible for all remaining errors. Thanks are due to Efthymia Mantellou for research assistance funded by ESRC/CAGE at Warwick University. This is a revised version of what we presented at the ESRC conference on ‘Diversity in Macroeconomics: new perspectives’, held at Essex University in February 2014.

*"The fox knows many things, but the hedgehog knows one big thing"* Archilochus of Paros

## 1. INTRODUCTION

### 1.1 *Berlin's Dichotomy*

In his celebrated essay on *The Hedgehog and the Fox*, the Oxford philosopher Isaiah Berlin (1953) drew on an ancient Greek aphorism to classify famous writers. He wanted to distinguish between those who view the world through the lens of a single defining idea, like a hedgehog whose big idea is to roll up in a ball in the face of any danger; and those more free-ranging types, like foxes, who draw on a wide variety of experience in the way they see the world and its problems. (Dante belongs to the first category, according to Berlin; Shakespeare to the second.)

Could this distinction not be applied to famous economists<sup>2</sup>? Views on who goes where will differ. We would, for example, be inclined to put Leon Walras, Karl Marx, and Milton Friedman in the first category, names indissolubly linked with General Equilibrium, with Capital and with Money, respectively. While John Maynard Keynes, Amartya Sen and Joseph Stiglitz would, for us, come in the second category.

Jagjit Chadha (2014) suggests that the thought-experiment can also help to illuminate different perspectives in the post-crisis debate on the state of macroeconomics. Thus, in surveying recent developments in Dynamic Stochastic General Equilibrium (DSGE) modelling, he says that the distinction made by Berlin "is a suitable classification to think about micro-founded macroeconomics versus the more subtle form of political economy that many seem to wish we used instead. I would like to think that such models provide a suitable single lens from which to start"<sup>3</sup>.

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<sup>2</sup> Chosen, for example, from those listed as the 'most important in history' in Luchinger (2007). In addition to those we refer to, the list also includes Adam Smith, David Ricardo, Friedrich von Hayek, Peter Drucker, John Nash and Hernando de Soto.

<sup>3</sup> Note however that, for Chadha, those who explore alternative approaches must be practitioners of political economy; that this is not necessarily so, we argue below.

## 1.2 *The Quest for Utopia*

What is it that micro-founded DSGE models have to offer that trumps all other perspectives? If DSGE thinkers do, in Berlin's words, 'relate everything to a single, universal vision in terms of which they understand, think and feel — a single universal organising principle in terms of which alone all that they are and say has significance', what is this vision?

It is, we suggest, a type of Utopian thinking, whose appeal lies in its promise to deliver attractive economic outcomes — peace and plenty for everyone for ever, so to say. In pursuit of Utopian ideals, it is customary to assume away inconvenient features of life as we know it; and modern macro is no exception. Thus, in his *Introduction to the New Keynesian Framework*, published in 2008, for example, Gali notes that 'The framework analysed in this book does not incorporate unemployment explicitly' and it 'assumes that capital markets are perfect'. Unemployment -- and other 'market imperfections' -- are left as issues for further research<sup>4</sup>: the main business in hand being to show how Enlightened Individualism can, in principle, deliver the goods!

A key assumption is that decision-making rests with a fully-informed Representative Agent gifted with rational expectations, served by efficient financial markets and blessed with a family whose members can trust each other implicitly. The Representative Agent supplies labour according to his or her ability and is rewarded with share of income equal to that of others in the family; and it is the maximisation of his/her utility that inspires the rules governing macro policy.

Inspired by this vision, many of the traditional features of macroeconomic debate can safely be ignored — the class conflicts of earlier Marxist thinking, for example; and the gross inequality highlighted by Piketty (2014) in *Capital in the 21<sup>st</sup> Century*. So too the distinction between savers and investors — and the resulting 'paradox of thrift' that Keynes believed to be characteristic of capitalistic societies. But, more than that, much of modern microeconomics — and all of game theory — also falls by the wayside: with only one agent,

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<sup>4</sup> See for example the subsequent analysis of unemployment in Gali, Smets and Wouters (2012).

there can be no issues of asymmetric information and principal/agent problems, nor conflicts of interest and strategic behaviour!

Lest this pen-picture seems exaggerated, consider what Robert Solow (2010) had to say in his presentation on DSGE models to the U.S. House of Representatives Committee on Science and Technology:

The DSGE school postulates its simplified economy with exactly one single combination worker-owner-consumer-everything-else who plans ahead carefully and lives forever. One important consequence of this “representative agent” assumption is that there are no conflicts of interest, no incompatible expectations, no deceptions<sup>5</sup>.

What this implies for stabilisation policy, Solow summarizes briefly as follows:

DSGE models have nothing useful to say about anti-recession policy because they have built into its essentially implausible assumptions the “conclusion” that there is nothing for macroeconomic policy to do.

For the convenience of the reader, key macroeconomic features of this new paradigm are reviewed **in Section 2**. There we highlight its links to the Real Business Cycle (RBC) approach as developed by Robert Lucas and Ed Prescott; and how it conflicts with the Keynesian paradigm it seeks to replace.

### ***1.3 The Choice of Micro-foundations***

One of the distinctive features of this new paradigm is its claim to rest on properly specified micro-foundations, which for New Keynesian Macroeconomics (NKM) means the economics of imperfect competition with prices and/or wages set by contract. Many other possible foundations could have been chosen<sup>6</sup>; but it was the economics of imperfect competition that was to prevail in models developed during the time of the Great Moderation, from the mid-1980s to the Great Recession. Here we focus in particular on the monographs by Woodford (2003) and Galí (2008): modern macroeconomics may have many fathers, but these are widely acknowledged as defining texts of the current paradigm.

### ***1.4 ‘Pecuniary Externalities’***

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<sup>5</sup> Solow notes that ‘the protagonists of this [representative agent] idea make a claim ... that it is founded in what we know of microeconomic behavior’, but he dismisses the claim, presumably for the reasons outlined.

<sup>6</sup> Those discussed in *New Keynesian Economics* (1991) edited by Gregory Mankiw and David Romer, for example; or from the fix-price/quantity-rationing models of *The New Macroeconomics*, edited by Hugh Dixon and Neil Rankin (1995)

There is nothing like a crisis to focus the mind: and the Global Financial Crisis of 2008/9 has switched attention to alternative micro-foundations involving features such as imperfect information and the unenforceability of contracts. Take the Credit Cycle model of Kiyotaki and Moore (1997), for example, where borrowers are required to pledge collateral as security for any loan<sup>7</sup>. This arrangement works well enough when borrowers experience idiosyncratic productivity shocks which are independently distributed: they can sell off collateral assets to pay off their debts without having much effect on collateral prices. But in the face of macroeconomic shocks (as when these idiosyncratic shocks become highly correlated), the concerted selling of such assets can lead to significant ‘pecuniary externalities’<sup>8</sup> – ‘fire-sales’ that lead to price over-shooting and possibly financial crisis. A similar feature occurs in Hyun Shin’s (2010) analysis of financial intermediaries, where correlated productivity shocks which increase the equity base of financial intermediaries can lead to boom/ bust cycles.

The link between micro and macro that emerges in these models may be roundabout; but it is nonetheless powerful. As discussed in **Section 3**, the common feature is that, given ‘agency problems’ in the financial sector, balance sheet rules are established to check the moral hazard involved. But, while these *micro-prudential rules* work well for idiosyncratic shocks, they can generate significant pecuniary externalities when shocks are correlated. How to mitigate these effects, as discussed in Korinek (2011) and Shin (2010) for example, is a key issue in the economics of financial regulation. Since it involves an externality it cannot be left to market forces to handle: it calls for *macro-prudential* policy measures.

What of the Coasian argument that the problem of pecuniary externalities must arise from ‘missing markets’? Such a perspective, with its objective of appealing to the First Welfare Theorem of competitive equilibrium, is, we argue, not well-suited to environments with asymmetries of information and strategic behaviour being considered here.

### ***1.5 Methodological Matters: the high road or the low road?***

Economists are not, by and large, given to discussing matters of methodology. But the emergence of a widely-accepted paradigm based on assumptions which effectively rule out the possibility of financial crises surely calls for comment in the aftermath of just such a crisis! Instead of taking the theoretical high road (of relying on putative extensions of the market paradigm to internalise such awkward externalities), we prefer to take the low road

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<sup>7</sup> Bernanke and Gertler (1989) work with a similar collateral constraint -- the net worth of the firm.

<sup>8</sup> As Greenwald and Stiglitz (1986) describe the side effects of price changes via balance sheet rules, etc.

(of allowing outcomes like the Great Depression or the Global Financial Crisis to fall within the ambit of macroeconomic models, see Wolf, 2014). Consequently, in Section 4, readers are reminded of Samuelson's Synthesis, the idea that one might combine the use neoclassical models of resource allocation at times of high employment, with Keynesian models of demand deficiency in depression. We suggest that this insight be expanded to include recent micro-founded models that accommodate both boom and bust.

Such multi-faceted constructs may not appeal to those who seek a universal model for all times and places; but the hope that all future events may be seen as the predictable unfolding of a given consistent and complete stochastic process is, we believe, a delusion. As Norbert Wiener (1993), celebrated for his pioneering work on stochastic processes, has himself pointed out<sup>9</sup>, there are developments that lie outside the bounds of prediction, inventions in particular -- and who can deny the capacity for invention displayed by those seeking their fortune in financial markets.

But is it academically acceptable to work with more than one macroeconomic approach? In respect of game theory, Gilboa et al. (2014) argue that what it has to offer is a set of carefully-specified, analytically-tractable 'analogies' to issues that arise in reality; so, in practice, the applied theorists will have to choose the right game for the problem at hand. The same logic, we believe, applies to macroeconomics.

## **2. BEFORE THE CRASH: THE SEARCH FOR UTOPIA**

The DSGE-style econometric models widely adopted by Central Banks in the period of the Great Moderation focussed on interest rate rules and omitted explicit consideration of money and banking<sup>10</sup>. Perhaps this was done to indicate a clean break from the monetarist tradition established by Milton Friedman? In Gali (2008), for example, passing reference is made to the narrative evidence provided by Friedman and Schwartz (1963) *A monetary history of the United States 1867-1960*; but what is taken to be most relevant are econometric studies of the effect of exogenous interest rate shocks on output and inflation in the US post World War II (WW II)

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<sup>9</sup> in an essay published posthumously.

<sup>10</sup> Banking does not appear in the index (nor 'money' in the title) of Michael Woodford's monograph on the foundations of a theory of monetary policy, called simply *Interest and Prices*; nor does it appear in the index of Gali's text entitled *Monetary Policy, Inflation and the Business Cycle*.

In any case, it was not monetary history, but the ideas of Robert Lucas, Friedman's successor at Chicago University, that set the agenda -- and the style -- for the new macroeconomics. Before turning to a canonical DSGE model, we start therefore with what Gali argues is its essential foundation, namely Real Business Cycle theory.

## **2.1 RBC (*without capital*)**

As is pointed out in Chapter 2 of Gali's monograph, for a Classical Monetary Economy 'the equilibrium dynamics of employment, output, and the real interest rate are determined *independently of the monetary policy*... output and employment fluctuate in response to variations in technology, which is assumed to be the only real driving force,' Gali (2008, p.20). So in the baseline model used in Chapter 2, as in the rest of the book, money's role is limited to being a unit of account, i.e. 'money is veil' -- "so that it make sense to analyse economic relations as if labour and commodities exchanged directly for each other" (Foley, 2006, p. 185).

The main predictions of the simplified RBC-without-capital approach is a tale soon told: with smoothly functioning factor markets, supply realises its full potential; and demand will match supply, thanks to Say's Law -- the principle that 'in aggregate, the demand for commodities arises from the willingness of households and firms to supply commodities' (Foley, 2006, p.184 ).

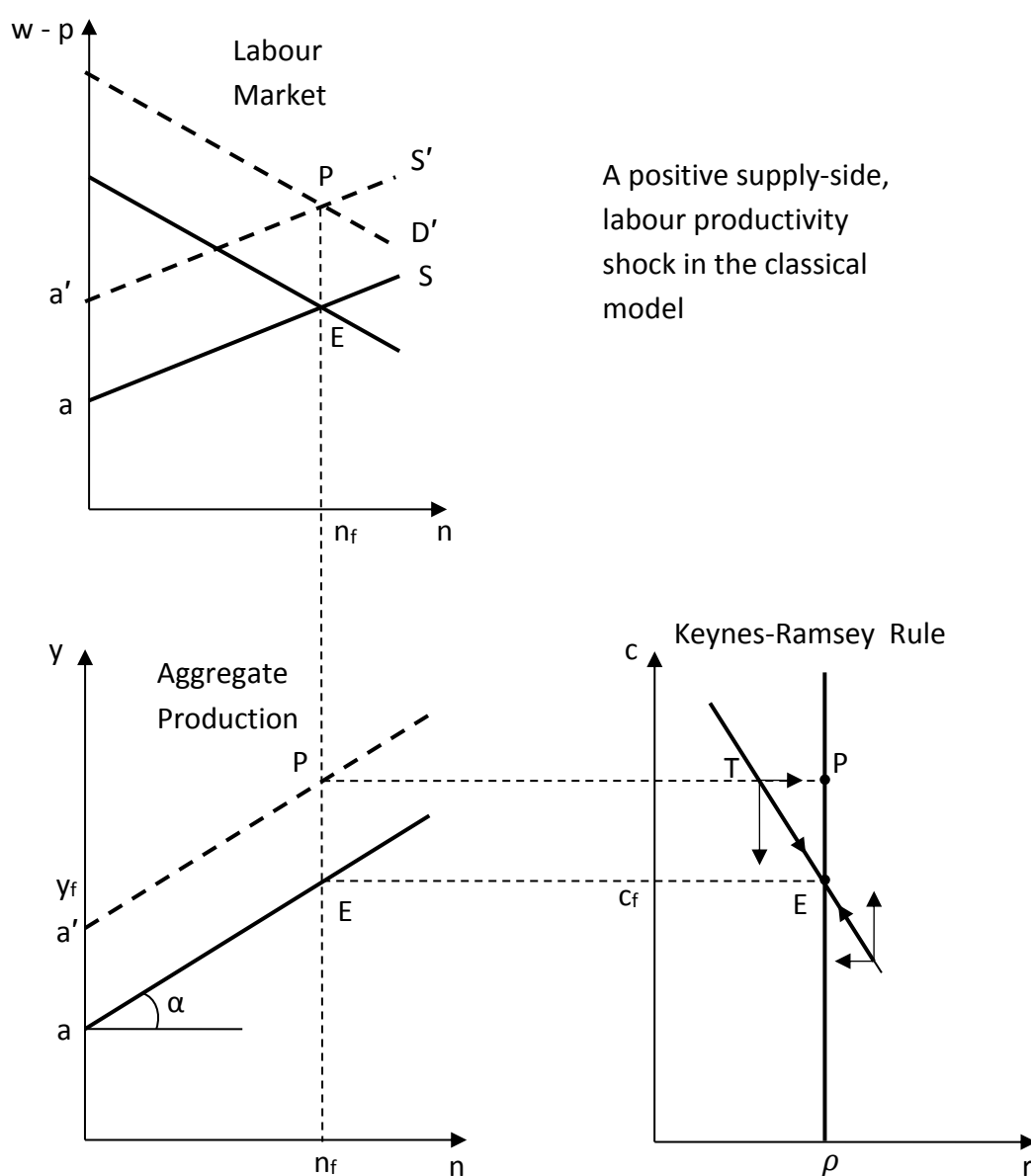
Using the log notation and equations of Gali (2008, Chapter 2), this is illustrated in Figure 1. There, aggregate demand and supply of labour, both depending on the real wage,  $w - p$ , and on the parameter,  $a$ , an indicator of aggregate labour productivity, appear in the top left panel, with market clearing giving full employment, at  $n_F$ . The aggregate production function (shown bottom right drawn on the assumption that the technology parameter is constant) defines potential output at  $y_F$ , with supply and demand shown labelled as  $E$  in both the bottom panels.

(Figure 1 near here)

## **2.2 Supply-side Shocks: Say's Law and the Keynes-Ramsey Rule**



The operation of Say's Law is apparent from considering a supply-side shock in the form of an unanticipated but permanent improvement in labour productivity of each and every firm, (as when  $a$  increases to  $a'$ ). In this case (assuming for convenience that the intertemporal elasticity of substitution  $\sigma$  is unity<sup>11</sup>), both labour demand and supply curves shift up to reflect the rise in productivity -- raising the real wage but leaving employment unchanged. The rise in productivity will increase potential output from  $E$  to  $P$  in the figure; and, since supply creates its own demand, consumption will – in this economy without capital -- increase promptly to the point also labelled  $P$ .



**Figure 1. Supply shocks, Say's Law and the Keynes-Ramsey Rule**

<sup>11</sup> as in the base case of Galí's calibrated model.

When considering a *temporary* supply-side shock (as when the initial improvement is reversed over time so  $a'$  reverts gradually to  $a$  following some autoregressive process<sup>12</sup>), the real interest rate must adjust so as to shape the path of demand over time. The Keynes-Ramsey Rule for inter-temporal optimisation<sup>13</sup>, in this setting requires that the growth rate of consumption decreases with the shortfall of the real rate of interest  $r_t$  below the pure rate of time preference  $\rho$ , as on the path leading from  $T$  back to  $E$  in the figure<sup>14</sup>.

More generally, the schedule passing through  $E$  shows the positive correlation of consumption growth and real interest rates predicted by the RBC model in the face of temporary supply shocks.

### ***2.3 The New Keynesian Model (NKM): Sticky Prices but No Money***

In his Introduction, Gali (2008, pp. 3-4) expresses some dissatisfaction with the RBC approach, however, pointing out that it is not consistent with econometric evidence on the effects of monetary policy in post WWII US; nor with the behaviour of Central Banks (who clearly believe that monetary factors matter for real outcomes). A more substantial role for monetary policy was therefore sought by adding monopolistic competition and nominal rigidities to the RBC structure -- leading to the emergence of DSGE models of the so-called New Keynesian variety. In this framework, monetary policy matters in that *unanticipated* changes in short term nominal interest rates impact on real variables.

Note that, to label these as 'New Keynesian' models of monetary policy, is potentially misleading for two reasons. First, because money and banking play no role whatsoever: nominal stickiness in wage and/or price setting is needed so that the Central Bank can change the real rate of interest by adjusting nominal rates, but this has nothing to do with the money supply. Second because, thanks to Say's Law, there is scant need for the 'demand management' that Keynes considered essential to stabilise output in modern capitalist economies<sup>15</sup>. It is clear from the structure of the model that unanticipated, permanent changes in supply, for example, call for no policy response. (As can be seen from Gali (2008, p.50)

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<sup>12</sup> Typically it is assumed that  $a_t = \rho_a a_{t-1}$ , where time is measured on a quarterly basis.

<sup>13</sup> First published in Ramsey(1928), which Gali writes as :  $E(c_{t+1}) - c_t = (r_t - \rho)/\sigma$  where  $1/\sigma$  denotes the inter-temporal elasticity of substitution in consumption. A more general formulation, in the context of capital accumulation with technical progress, is provided in Blanchard and Fischer (1989, p.43).

<sup>14</sup> For the autoregressive process specified in footnote 12, this path will have a slope of  $-1/(1 - \rho_a)$ , so it is less than vertical for  $1 > \rho_a > 0$ , with the initial change in the real rate measured on a quarterly basis given by the parameter  $\rho_a$ .

<sup>15</sup> As discussed for example in Foley (2006, Chapter 5) and in Skidelsky (2009).

for  $\rho_a = 1$  there will be no change in the implied natural rate  $\hat{r}_t^n$  nor, consequently, in the output gap or inflation.) So in terms of the real variables shown in Figure 1, the NKM replicates the results of the simplified RBC model.

This example serves to illustrate another striking feature of the NKM model. As Paul De Grauwe (2014) has pointed out, despite the inclusion of sticky prices and monopolistic behaviour, *the canonical DSGE economy has no endogenous dynamics*: as we have just seen, both output and employment will adjust immediately and completely to the productivity shock. This is a symptom of the rational expectations revolution (and the simplicity of the model under consideration which omits investment).<sup>16</sup>

What if there is some dynamics involved -- as when *future* changes in productivity are expected? In the case where the productivity shock is expected to change the time-form of supply, some action by the Central Bank will be required. But the results for a temporary technology shock reported in Gali (2008, Table 3.2, p.55) show that policy adjustments to the nominal interest rate in line with the time-profile of the productivity shock allow the real interest rate to move much as for the RBC model of Figure 1 above; so 90% of the output increase is absorbed on impact -- and a higher percentage thereafter. Of course policy could do worse: as is shown by simulations where rates are adjusted to hit a money supply target -- with employment falling markedly more, and the loss of about three quarters of the potential expansion.

What then has been achieved by adding monopolistic competition, price stickiness and the Taylor rule to the RBC framework? Four things:

(1) Money has been excluded from consideration; and a ‘money supply rule’ shown to be inappropriate for supply side shocks. Friedman has been dethroned.

(2) Say’s Law has been largely preserved: so Keynes can be forgotten. As Lucas puts it:

At research seminars, people don’t take Keynesian theorizing seriously any more -- the audience starts to whisper and giggle to one another. Leading journals aren’t getting Keynesian papers submitted any more. I suppose that I, along with many others, was in on the kill in an intellectual sense, but I don’t say this as any kind of boast, or even with much pleasure. It is just a fact. Lucas (2013, p. 500)

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<sup>16</sup> As Daros and Rankin (2009) point out this implies that there is in fact no persistence in the response of the output to the interest shocks in the NKM. The persistence reported in Figure 3.1 in Gali (2008) must therefore be attributed to the exogenous persistence of the monetary shocks.

(3) Apart from price stickiness, there are no inherent dynamics: output and employment are jump variables. So shocks that do not call for price adjustment will have the same effects as in RBC.

(4) With frictions in price adjustment, central bank policy can change real interest rates. Action to change real rates to match future anticipated changes in supply can lead to losses of potential; but these are mild and temporary.

This brief summary is enough to suggest that the NKM framework is unlikely to help understand financial crisis. The explicit exclusion of financial factors effectively rules out threats to financial stability, such as asset bubbles or bank runs: balance sheets, detailing the holding of financial assets (including money) and liabilities (including debt) don't apparently matter<sup>17</sup>.

Nor will it offer a coherent account of Central Bank interest rate adjustments aimed at demand management -- in the face of precautionary saving in the aftermath of financial crisis, for example (Challey and Ragot, 2013). There is no uncertainty in the simulations; and no role for the precautionary holding of money.<sup>18</sup> The implication of the simulations is rather that the Central Bank should take the Hippocratic oath to 'do no harm'.

### **3. FROM MICRO TO MACRO: THE MILLENIUM BRIDGE**

As Adam and Eve, on leaving paradise, felt the need to cover their nakedness, so, when one leaves the Utopia of the Representative Agent, the need for more sophisticated microeconomics becomes apparent. With asymmetric information, for example, principal/agent problems come crowding in; and leaving things to market forces is much less plausible when there are issues of market dominance and externalities to be faced. On examining the handiwork of economists who have confronted these issues (as they affect the demand and supply for credit), however, we find a fascinating result: steps to mitigate microeconomic principal/agent problems may themselves act to create macroeconomic externalities!

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<sup>17</sup> This is hardly surprising as the differences in time preference or investment opportunities that typically motivate borrowing and lending are ruled out by the Representative Agent assumption.

<sup>18</sup> As analysed in Kiyotaki and Moore (2008), Del Negro et al. (2011) and Driffill and Miller (2013), for example.

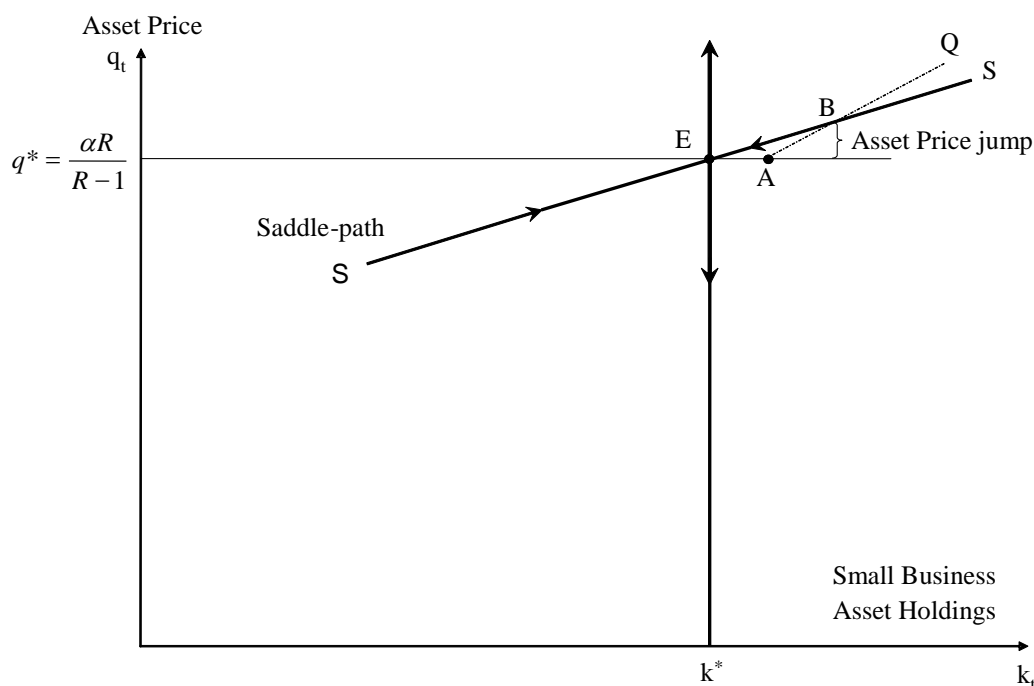
For the ‘financial accelerators’ reviewed in this section, these ‘pecuniary externalities’ operate directly through balance sheet pressures on borrowers or lenders. An analogy popularised by Hyun Shin may help to illustrate: the saga of the Millenium Bridge across the River Thames when first opened to pedestrians in 2000. The chosen structure was not rigid; it was somewhat elastic so it could move with gusts of wind; and, for planning purposes, it had been assumed that the pedestrian traffic of office-workers and tourists would not be walking in step. On opening day, as pedestrians first flocked across the bridge, they were indeed out of step: but not when gusts of wind caused the structure to sway. Walkers in each direction, thrown sideways onto the same foot at the same time, fell into step -- and the bridge, picking up the harmony, began to sway so badly that it had to be closed that day – and for many months thereafter as it underwent serious restructuring. The alarming swaying motion was the unintended consequence of choosing a flexible structure that, with pedestrian traffic, acted to amplify the effect of random gusts.

### ***3.1 Demand-side Pro-cyclicality: a ‘Financial Accelerator’***

Even without financial intermediaries, a credit-constrained market economy – where collateral is used to handle repudiation risk – can exhibit credit cycles and collapsing asset prices thanks to the externalities acting via the price of collateral. In the classic heterogeneous agent model of Kiyotaki and Moore (1997), for example, highly productive Small Business entrepreneurs wish to raise outside finance to acquire the fixed capital assets (which they employ with constant marginal productivity  $\alpha$ ) but face an agency problem because the ‘human capital’ used in the business is ‘inalienable’. Recourse is taken to the issuing of debt backed by physical collateral, priced to reflect its productivity outside the entrepreneurial sector (i.e. in the hands of the ‘deep pocket’ lenders, who face declining marginal productivity).

In the face of uncorrelated, idiosyncratic productivity shocks, individual agents adversely affected can sell capital and pay down debt without affecting asset prices. But in the face of an adverse *macroeconomic* shock to entrepreneurial productivity, the borrowing constraint can lead to ‘fire-sales’ which affect the price of the collateral and trigger yet further sales, i.e., there is a pecuniary externality. This is in sharp contrast with the ‘first best’ economy where all agents are unconstrained in the credit market, and prices and production are unaffected by net worth.

Thanks to the immediate increase in net worth easing their credit position, Small Businesses can collectively acquire the additional amount of collateral *EA*. But, like the swaying of the Millenium Bridge when hit by a gust of wind, this initial shock will be amplified as the extra demand pushes up the price of collateral -- enabling these entrepreneurs to go yet further on the acquisition trail. The effect of this 'financial accelerator' is shown the movement from *A* to *B*, which can be many times as large as the initial shock. Like the bridge settling down when the wind stops gusting, however, the allocation of assets will -- absent further shocks -- move gradually back to equilibrium as shown by the arrow from *B* to *E*.



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What happens if the initial shock is negative? In this case, the accelerator goes into reverse and asset prices have to fall until, at point *X*, the balance-sheet-driven ‘demand for liquidity’ by Small Businesses is matched by the ‘supply of liquidity’ by the residual buyers the agents with ‘deep pockets’.

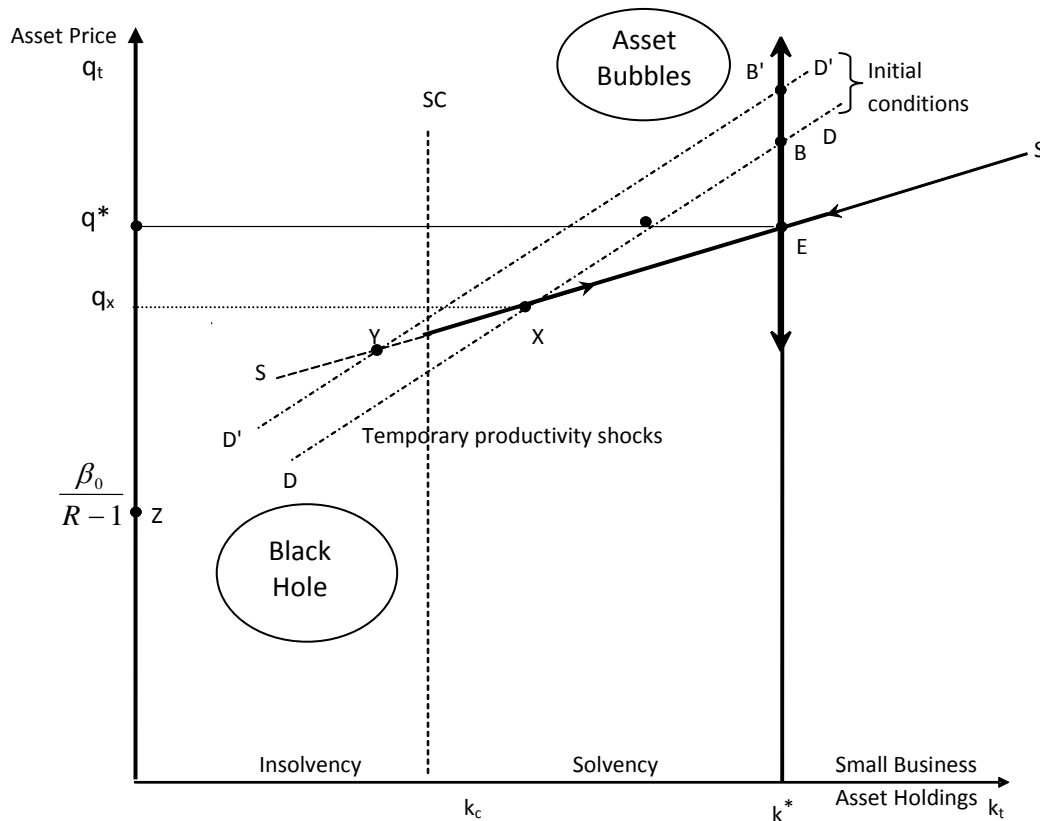
Is there not a risk that highly-leveraged borrowers -- trying to pay down their debts by disposing of assets in a ‘fire-sale’ – will become insolvent in the process? This outcome is shown for a larger shock, where the asset disposals are indicated by the schedule labelled *D'D'*; and the line *SC*, indicating the Solvency Condition, is crossed before the demand for liquidity is met by supply, as at point *Y*. In this case, unless they can get bankruptcy protection, debtors will go out of business with all their assets taken over by their creditors.

A different interpretation of this process is suggested in Miller and Stiglitz (2010), namely that the shock is the ending of an asset bubble (rather than an adverse shift of productivity). Imagine, for example, a growing asset bubble -- as indicated by the arrow pointing upwards from *E*, and the label alongside -- with Small Businesses expanding their borrowing in line with rising collateral values until it bursts. (On this interpretation, *DD* and *D'D'* can be interpreted as disposal schedules following the ending of the asset bubble at *B* or at *B'* respectively.) Note that when the bubble bursts asset prices ‘overshoot’ equilibrium on the way down: but if the bubble is large enough, they will not recover. With a whole segment of the market – productive Small Businesses – losing control of the productive asset, the price of capital falls to *Z*, based on the marginal product of Deep Pockets (which falls to  $\beta_0 < \alpha$ , as they are now the only producers and face declining marginal productivity).

Assuming only productivity shocks, Kiyotaki and Moore (1997) ignore the possibility that ‘overshooting’ might be severe enough to render the illiquid agents insolvent: with bursting asset bubbles, however, the risk of widespread insolvency seems much more plausible -- as Ricard Koo (2008) indicates in his analysis of events in Japan (where from a peak of nearly 40,000 in 1989 the Nikkei stock index plunged to 15,000 in 1992). The region to the left of the solvency condition is labelled a Black Hole in Figure 3<sup>19</sup> by analogy with those regions of the cosmos where stars have collapsed and (almost) nothing can escape.

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<sup>19</sup> as in Miller (2009).





such as Credit Default Swaps “which [are] likely to require large payouts precisely in times of financial turmoil” (p. 27).

### ***3.2 Supply Side Pro-Cyclicality: Endogenous Risk-premia***

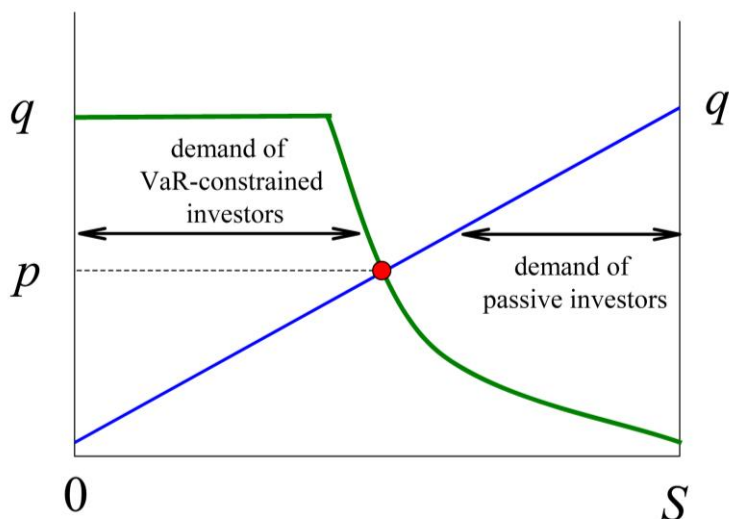
Consider now the pro-cyclicality coming from balance sheet pressures operating on the ‘supply-side’ of the credit market. In a paper written before the financial crisis erupted<sup>21</sup>, Adrian and Shin (2007) warned of the pro-cyclical behaviour of financial intermediaries who actively manage their balance sheets subject to a Value-at-Risk (VAR) constraint. The argument is essentially that a change in the market value of assets already held allows the leveraged financial sector to change its supply of loans by a multiple of the initial shock to its balance sheet.

A positive shock to asset values, for example, will raise the equity proportion of the intermediary’s balance sheet and reduce the leverage. To restore the profit-maximising debt/equity ratio, the intermediary can take on additional debt and make additional loans. As a consequence, they argue, financial intermediaries which amplify real shocks in this fashion can lead to a boom/bust cycle.

To show this, Adrian et al. (2010) indicate how active balance sheet management can lead to a compression of the risk premium after a positive shock. The figure they use, reproduced here as Figure 4, shows how the price of risky assets is determined before the shock. On the horizontal axis is the amount of the risky asset, with valuations plotted on the vertical axis, where  $q$  is the expected pay-off, and  $p$  the market price. The blue line represents the demand schedule of a representative, mean-variance, unlevered investor (measured from the right of the figure) while the kinked green line is the demand schedule for VaR-constrained, active intermediaries (measured from the left); and the convex portion of the green schedule indicates where the VaR constraint is binding.

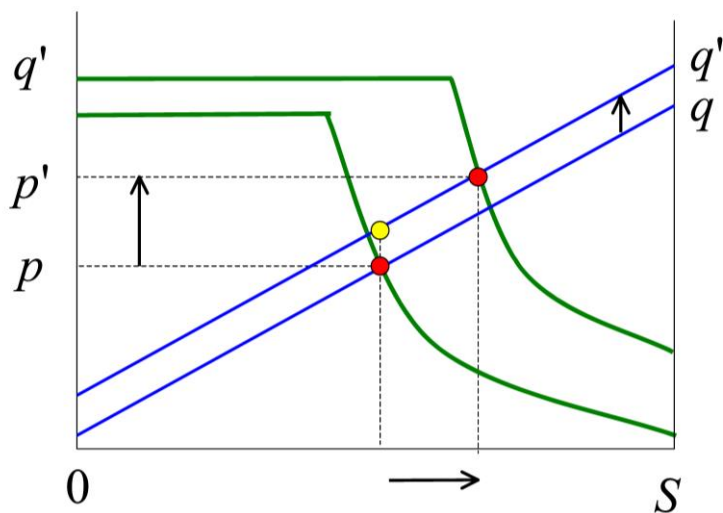
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<sup>21</sup> Published later as “Liquidity and Leverage” Adrian, Moench and Shin (2010).



**Figure 4. Determination of Risk Premium**

The equilibrium price is shown as  $p < q$ ; and, in a one period setting, the expected yield from the risky security is given by  $r = (q/p) - 1$ , which they refer to as the risk-premium.



**Figure 5. Compression of Risk-premium from Increase in Intermediary Balance Sheets**

How this risk spread (or risk premium) falls in response to a positive shock is illustrated in Figure 5, where a favourable shock to the fundamental of the risky security raises demand from both sectors, but:

... there is an amplified response from the leveraged institutions as a result of marked-to-market gains on their balance sheets and (crucially) the balance sheet quantity adjustments entailed by it. (Adrian et al., 2010).

This perspective they argue is different from that of Curdia and Woodford (2009) who also introduce a credit spread

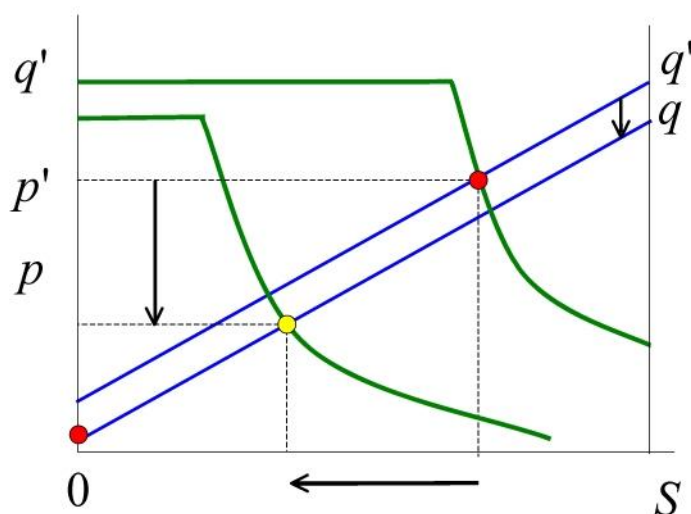
but the intermediaries remain passive entities that provide a risk-sharing service to households with differing shocks to wealth. (Adrian et al., 2010, p. 6)

Accordingly, they suggest how the standard New Keynesian model of Woodford (2003) should be modified to incorporate this endogenous risk premium: two new equations are required to determine the risk premium and the ‘risk appetite’ of intermediaries, which varies in response to shocks as discussed above.

### ***Boom and Bust***

In his discussing the effect of increasing the volume of lending, Shin (2010, p. 41) argues that “[T]he assumption that the pool of potential borrowers have projects that are perfect substitutes for existing projects being funded is ... unlikely to hold in practice ... In the subprime mortgage market in the United States in the years leading up to the financial crisis of 2007, we saw that when balance sheets are expanding fast enough, even borrowers that do not have the means to repay are granted credit – so intense is the urge to employ surplus capital.”

Instead of lowering the quality of new lending, another way of capturing the seeds of downturn would be to assume the quality improvement discussed above was mistaken. In Figure 6, we illustrate what happens when the mistake is realised, so both schedules return to their original positions. The passive investors will of course suffer a capital loss, but the leveraged investors may well take a bigger hit, as shown in the Figure, leading to insolvency if mark-to-market losses exceed their equity base.



**Figure 6. Boom and bust**

Two possibilities are shown: first the extreme case where all leveraged investors go broke leaving assets solely in the hands of passive investors (with equilibrium shown on the left hand axis); the other (shown in the middle of the diagram) is where some of the leveraged investors have gone out of business. In both cases, we get a substantial collapse of asset prices relative to their starting level. (We assume there is no new entry when the asset prices go up but there is exit when asset prices go down.)

### ***Policy Prescriptions***

Shin (2010, pp. 171-2) summarises the unpublished ‘LSE critique’ of Basel II, Danielsson et al. (2001)<sup>22</sup>, as follows:

The flaw with Basel II lay ... in its twin assumptions – that the purpose of regulation is to ensure the soundness of individual institutions against the risk of loss on their assets, and that ensuring the soundness of each individual institution ensures the soundness of the system as a whole.

What types of macro-prudential policy can check such system-wide externalities? In discussing how to moderate the boom/bust cycle Shin (2010, pp. 161 ff.) considers three “prescriptions”: regulatory intervention, forward-looking provisioning, and the reform of financial intermediary institutions to shorten the credit chain.

<sup>22</sup> a paper submitted to the Basel Committee but essentially ignored.

By way of regulatory intervention what is proposed are “leverage caps or countercyclical capital targets aimed at restraining the growth of leverage in boom times so that the corresponding bust phase of the financial cycle is less damaging, or can be avoided altogether” (Shin, 2010, p. 162). Forward-looking provisioning is recommended as a way of acting directly on the equity of financial intermediaries -- and the provisioning scheme of Spain is cited as a good example. The third proposal is for institutional reform, aided perhaps by the issuance of covered bonds – bonds issued on a bank’s balance sheet, with recourse against the issuing bank itself.

In discussing the run on Northern Rock, he also suggests that a liquidity requirement be added to a leverage ratio to mitigate system-wide externalities, noting that:

Financial regulation ... has the role of imposing the appropriate Pigovian taxes that internalize the externalities as much as possible. The Pigovian tax perspective is likely to yields better insights into system stability than the traditional risk-based capital requirements under the Basel process. Shin (2010, p. 151)

### ***3.4 Missing Markets: the Coasian Alternative***

A feature common to both examples presented in the last section is that imposing “micro-prudential” regulations to ensure the proper behaviour at the individual level (be it a collateral requirement for an entrepreneur in debt or a VaR measure for an intermediary lender) can have unintended macroeconomic consequences. As pecuniary externalities may operate when the system is hit by an aggregate shock, “macro-prudential” regulations are proposed to reduce the unintended macroeconomic effects<sup>23</sup>.

But what if the occurrence of pecuniary externalities is attributed to ‘missing markets’? There is, after all, a distinguished tradition associated with the name of Ronald Coase (1960) that analyses externalities in this way. So, rather than thinking in terms of regulation to restore Pareto efficiency given the existing structure of property rights, one could in theory extend

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<sup>23</sup> For recent comprehensive discussion on macro-prudential regulations in financial markets, see Schoenmaker (ed.) (2015); and for an earlier treatment focusing on externalities see De Niccolo et al. (2012).

the range of property rights and leave the solution to the market; and, in the absence of ‘transactions costs’, this should restore economic efficiency<sup>24</sup>.

Why not apply this here? The logic has its attractions, not least because it can appeal to the First Welfare Theorem of economics to support its claim to efficiency. This may be its strength, but it is also an indication of its limitations – namely that it rests on the assumption that the economy is characterised by perfectly competitive, price-taking behaviour, with no informational advantages, no awkward non-convexities, etc. To label departures from efficiency as “transactions costs” that may – for convenience – be assumed away, runs the risk of ignoring essential features of the situation: such as significant asymmetries of information and market power<sup>25</sup>. Indeed, if the ‘transactions costs’ to be assumed away include these and – why not? -- all other potential departures from the Arrow-Debreu model of the market economy, then the Coasian approach becomes true by definition!

For sure, applying the Coasian approach to the ‘pecuniary externalities’ being considered here would suggest a very different agenda, and might push reform in fruitful directions – to implementing ‘sunshine trading’ rules like those imposed to increase market transparency after the 1987 stock market crash in the US, or to putting Over-The-Counter derivatives-trading onto exchanges for similar reasons; or in the direction of structural changes that restore competitive balance between institutions, by ending Too Big To Fail, for example. But as a guiding philosophy for thinking about how to improve the operation of the economy -- and of financial markets in particular -- it seems a peculiarly indirect route. For, instead of focussing on a specific problem -- be it ‘excessive risk-taking’ or ‘fire sales’ -- and on prudential regulations to check them, one is invited instead to imagine how an economy without missing markets might have avoided such issues.

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<sup>24</sup> Note, however, that the identification of ‘missing markets’ is but the first step in this process: next one has to explain why these markets are not operative, being careful not to appeal to factors which violate the assumptions of the Arrow-Debreu model; and finally one must show how and why the government can improve on this equilibrium.

<sup>25</sup> To demonstrate what “transactions costs” may include, consider the basic model of a market for housing sketched in Binmore (2007, pp. 466 and 588). Based on Myerson and Satterthwaite (1983), it is shown that, given asymmetric information as to the quality of the property and the incentives to act strategically, it is shown that houses will change hands at only when worth a lot more to the buyer than the seller, as sellers exploit their information ‘monopoly’.

At the very least, this involves prioritising a specific model (Arrow-Debreu) with all its special assumptions. Is there not, moreover, evidence to suggest that this approach could in practice lead in the wrong direction? The widespread deregulation of financial markets prior to the financial crisis was, after all, backed by the claim that more competition — accompanied by self- or light-touch regulation — would deliver increased economic efficiency. Those who promoted the development of new financial markets — and the deregulation of those that existed — got what they wanted precisely by appealing to the efficiency claims of the competitive model!

It is easy, in retrospect, to see that those claims were too naïve — that there were profound distortions of information and competition that could and did lead to crisis. But the limitations of the competitive model evidently escaped the notice of Alan Greenspan (the highly-regarded chair of the Federal Reserve Board who was knighted in 2002 for his contribution to global economic stability) — until a shattering financial crisis led him to reconsider his views, Greenspan (2013). Why then should prioritising such an approach be the way to think about the problems that caused the crisis? Instead of proposing putative markets contingent on all manner of events in a competitive environment, should the focus not be on the more obvious failures of the competitive model as applied to financial intermediation where asymmetries of information are endemic?

## **4. METHODOLOGY MATTERS**

### ***4.1 Samuelson's Synthesis***

On a book-jacket decorated with a screen-print entitled 9\$ by Andy Warhol, Gali's monograph is described by Mark Gertler as 'a wonderfully elegant and accessible introduction to the contemporary New Keynesian paradigm, ...[which] presents what one should know in a clean, cogent, and concise manner'. Apart from an appreciation of the Classical approach, however, it contains very little by way of monetary and intellectual history. As its publication in 2008 coincided with the onset of the worst financial crisis in the US and the UK since the Great Depression, the decision to ignore money and banking -- which may have seemed natural using RBC as the point of departure -- seems in retrospect a drastic strategic error.

Why should modern-day macroeconomists choose so decisively to ignore the writings of Keynes and Friedman (not to mention Minsky) in this way? Perhaps because the Utopian urge, discussed earlier, is buttressed by the state-of-the-art methodology being employed. As Gali (2008, p.2) notes:

From a methodological point of view, RBC theory firmly established the use of dynamic stochastic general equilibrium (DSGE) models as a central tool for macroeconomic analysis. Behavioral equations describing aggregate variables were thus replaced by first-order conditions of inter-temporal problems facing consumers and firms. Ad hoc assumptions on the formation of expectations gave way to rational expectations.

So what one is being offered is a structure cut loose from conventional empirical moorings, in the form of equations for consumption, investment, the demand for money, etc.: it is based instead on the putative behaviour of infinitely-lived agents armed with rational expectations (and incidentally complete markets for insurance).

The intellectual confidence expressed in the techniques and the theory – and the nomenclature being used -- may lead one to wonder: is macroeconomics formulated in this way claiming to be treated as a science? The survey article on New Keynesian Economics by Clarida et. al (1999) is, for example, called “The Science of Monetary Policy”. Likewise the book of essays in honour of Michael Woodford, edited by Volker Wieland (2010), carries the title *The Science and Practice of Monetary Policy Today* (and Woodford’s monograph is described by Bennett McCallum as “the most important treatise on monetary economics in over 50 years... likely to go down in intellectual history as one of the handful of great books on this topic”).

According to Hicks (1983), one of the distinguishing features of science is that the current state of the subject is all you need to know: prior history may be of interest *qua* history, but it is not necessary for understanding the subject and its predictions. This does indeed seem to be the perspective taken in Gali’s book. But in Hicks’s view economics is not like that: the current state is not a ‘sufficient statistic’ for all previous economic investigations.

Macroeconomics, he argues, has techniques that are useful in addressing specific problems – of high inflation or deficient demand, for example, or economic growth and decline. As the actual problems to be faced keep changing over time, so the history of economics is useful as



a record of how they were in practice tackled; and Hicks concludes that “economics is a discipline not a science”<sup>26</sup>.

In addition, of course, the challenge of adopting the mantle of science is that of ‘falsifiability’ -- with the corollary that if the predictions are wrong the model should be rejected<sup>27</sup>. To argue that DSGE models, which failed to forecast (or to encompass) the Global Financial Crisis of 2008/9 and the Great Recession that followed, will succeed if only ‘financial frictions’ are added ex post runs the risk of failing this test.

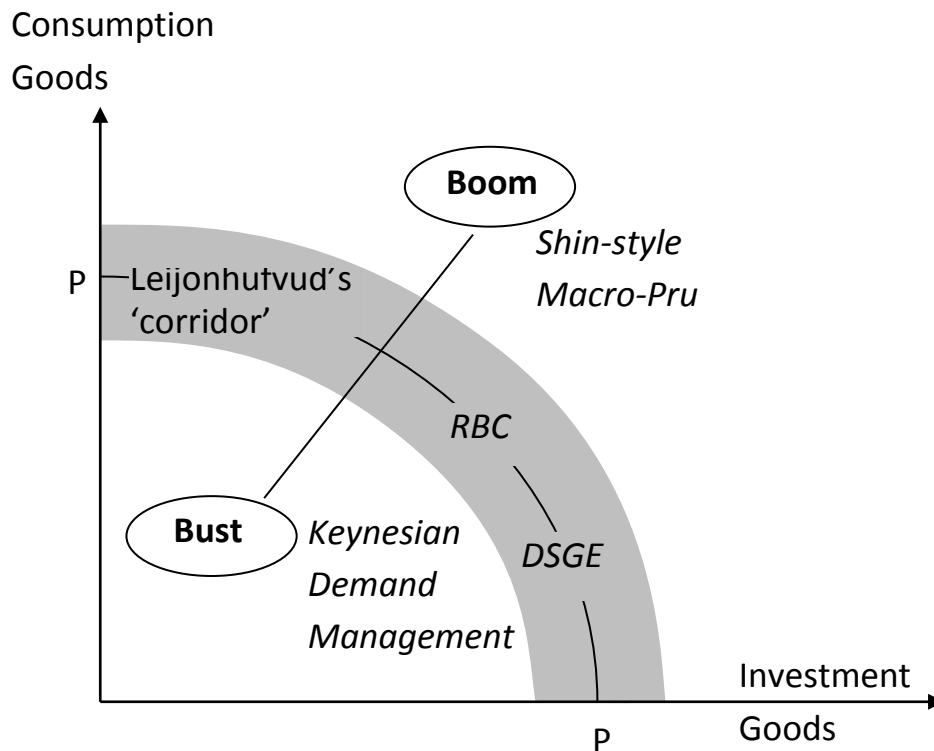
An alternative to choosing one universal macro-model is the strategy of synthesis proposed by Paul Samuelson. The idea is that different approaches or models be used in markedly different states of the economy. As Axel Leijonhufvud (1981, pp. 109-110) explained it:

The [economic] system is likely to behave differently for large than for moderate displacements from the “full coordination” time-path. Within some range from the path (referred to as “the corridor” for brevity), the system’s homeostatic mechanisms work well, and deviation-counteracting tendencies increase in strength. Outside that range these tendencies become weaker as the system becomes increasingly subject to “effective demand failures”. If the system is displaced sufficiently “far out”, the forces tending to bring it back may, on balance, be so weak and sluggish that – for all practical purposes – the Keynesian “unemployment equilibrium” model is as sensible a representation of its state as economics statics will allow. Inside the corridor, multiplier-repercussions are weak and dominated by neoclassical market adjustments; outside the corridor, they should be strong enough for effects of shocks to the prevailing state to be endogenously amplified.

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<sup>26</sup> A perspective discussed further in Miller (2011)

<sup>27</sup> As a test of its predictive and/or explanatory power, consider how well the NKM of Gali published in 2008 can be used to account for the Great Recession that followed the sub-prime crisis of 2008/9.



**Figure 7. Samuelson's Synthesis – with update**

Figure 7 provides a simple graphical summary, where potential output is represented by the production possibility frontier  $PP$ . The 'corridor' around  $PP$  indicates states of high employment where RBC and DSGE models may be judged appropriate; with recourse to Keynesian demand management being called for if resources are grossly underutilized and the economy lies substantially inside the production possibility frontier.

#### ***4.2 Economics as Analogy***

In a recent essay, Paul Krugman (2011) concedes that the Samuelson Synthesis 'requires some strategic inconsistency in how you think about the economy. When you're doing micro, you assume rational individuals and rapidly clearing markets; when you're doing macro, frictions and ad hoc behavioural assumptions are essential'. For this reason, he concludes that it is not intellectually stable. For policy-makers, he argues, such inconsistency might be acceptable, but 'economists were bound to push at the dividing line between micro and macro – which in practice has meant trying to make macro more like micro, basing more and more of it on optimisation and market-clearing'.

Perhaps Krugman is being too pessimistic. In a recent paper on the nature of economics Gilboa et al. (2014) argue that economic models are typically elaborate ‘case studies’ fitted to particular circumstances – to be employed with care elsewhere. Hence, it would seem, the choice of model and policy could be adjusted as best suits the regime. During the Great Moderation, for example, an NKM style model with a Taylor rule could be appropriate; but this should be suspended during the Great Recession, in favour of fiscal stimulus and QE, followed by Forward Guidance to exit.

Maybe it is time to revive the Samuelson Synthesis, with expectations formed differently in different regimes, each locally stable until hit by a shock. In the corridor, for example, rational expectations rule, in the boom there is "irrational exuberance" and in the bust the pessimism (where demand is depressed due to, say, precautionary motives) -- calling for determined Shin-style ‘macro-pru’ in boom times and Keynesian-style demand management in recession, as illustrated in Figure 7.

## **5. CONCLUSION: SOLOW’S SIGNPOST**

At the end of his testimony to the US Congress, Robert Solow (2010) posed a question for the sociology of knowledge: to explain ‘why the macroeconomic profession took this almost thirty years detour that brought us to the present mess’. For his part, he recommends that one ‘leave such questions to historians and [instead] start right now in a new analytical track’.

We have volunteered an answer to Solow’s question: that, like conquistadors of old in search of El Dorado, modern macroeconomists in search of Utopia have been willing to believe whatever would make their dreams come true -- beliefs that include an eternally-lived Representative Agent, fully Efficient Financial Markets -- and expectations consistent with both. Bold assumptions indeed: but great is the promised reward. So what if they are mistaken? Then, like faithful followers of Dr Pangloss, the inhabitants of DSGE-land will be condemned to suffer the wretched fate of Voltaire’s *Candide*; until such time as they finally realise that ‘All is not for the best, in the best of all possible worlds’-- and turn to alternative perspectives.<sup>28</sup>

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<sup>28</sup> This could be the fate those living in Euro-land, as long as the ECB continues to design its policy with a DSGE model, as we argue in a VoxEU paper ‘To exit the Great Recession, central banks must adapt their policies and models’, Miller and Zhang (2014)

Samuel Taylor Coleridge once suggested that, if a writer could infuse "human interest and a semblance of truth" into a fantastic tale, readers would suspend judgement concerning the implausibility of the narrative. This may well be true in poetry, theatre and film; but what about economics? It is true that many economists have been persuaded to suspend their disbelief by the 'clean, cogent, and concise' style of modern macro: but fortunately not all!

The research on 'pecuniary externalities' outlined above recognises the risk of moral hazard that comes with imperfect information, and the rules that have evolved to check it. In showing how these rules can nevertheless amplify macro shocks, it offers a new variety of micro-founded macroeconomics; together with an intellectual case for 'Macro-pru' to check such unintended side-effects. Writing in (2012), De Niccolo and colleagues at the International Monetary Fund also expressed the view the *raison d'être* for macro-prudential policy is to correct externalities. Could this be the 'new track' that Solow has sign-posted?

## REFERENCES

- Adrian, T. and H. S. Shin (2007), "Liquidity and Leverage," working paper, Federal Reserve Bank of New York and Princeton University. Available in: *Cycles, Contagion, Crises*, LSE Financial Market Group Conference June 2007, Special Paper Series No. 183 (2008). Published as: Adrian, T. and H. S. Shin (2008), "Liquidity and leverage", *Journal of Financial Intermediation*, 19(3), pp. 18-437.
- Adrian, T., E. Moench and H. S. Shin (2010), "Macro Risk Premium and Intermediary Balance Sheet Quantities", *IMF Economic Review*, 58(1), pp. 179-207.
- Berlin, I. (1953), *The Hedgehog And The Fox: An essay on Tolstoy's view of history*. London: Weidenfeld and Nicolson.
- Bernanke, B. S. and M. Gertler (1989), "Agency Costs, Net Worth, and Business Fluctuations", *American Economic Review*, 79, pp. 14-31.
- Binmore, K. () *Playing for Real*
- Blanchard, O. J. and S. Fischer (1989), *Lectures on Macroeconomics*, Cambridge, MA: MIT Press.
- Chadha, J. (2014) "Financial frictions and macroeconomic models: a tour d'horizon", *European Journal of Economics and Economic Policies: Intervention*, Vol. 11 No. 1, 2014, pp. 80-98
- Challey, E. and X. Ragot (2013), "Precautionary Saving over the Business Cycle", mimeo, Paris School of Economics.
- Clarida, R., J. Gali and M. Gertler (1999), "The Science of Monetary Policy: A New Keynesian Perspective", *Journal of Economic Literature*, 37, pp. 1661-1707.

- Coase, R. H. (1960). "The Problem of Social Cost". *Journal of Law and Economics* 3 (1): 1–44.
- Curdia, V. and M. Woodford (2009), "Credit frictions and optimal monetary policy", Bank for International Settlements (BIS) Working Paper Series No 278.
- Danielsson, J., P. Embrechts, C. Goodhart, F. Muennich, C. Keating, O. Renault and H. S. Shin (2001). "An Academic Response to Basel II", LSE Financial Market Group Special Paper 130.
- Daros, S and N Rankin, (2009), "Output persistence from monetary shocks with staggered prices or wages under a Taylor Rule", *Economics Letters*, 105, 148-151.
- DeGrauwe, P. (2014), Unpublished Paper Presented at the ESRC Conference on 'Diversity in Macroeconomics: new perspectives', Essex University (February).
- De Niccolo, G., G. Favara, and L. Ratnovski, (2012), "Externalities and macroprudential policy" Staff Discussion Note 12/05, IMF.
- Del Negro, M., G. Eggertsson, A. Ferrero and N. Kiyotaki (2011), "The great escape? A quantitative evaluation of the Fed's liquidity facilities," Staff Reports 520, Federal Reserve Bank of New York.
- Dixon, H. and N. Rankin (1995), eds., *The New Macroeconomics*, Cambridge: Cambridge University Press.
- Driffill, J. and M. Miller (2013), "Liquidity When it Matters: QE and Tobin's Q", *Oxford Economic Papers*, 65(supplement1), pp. i115-145.
- Foley, D. K. (2006). *Adam's Fallacy: A Guide to Economic Theology*. Cambridge MA: Harvard University Press.
- Friedman, M. and A. Schwartz (1963), *A monetary history of the United States 1867-1960*. Princeton NJ: Princeton University Press.
- Gali, J. (2008), *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework*, Princeton and Oxford: Princeton University Press.
- Gali, J. & F. Smets and R. Wouters, (2012). "Unemployment in an Estimated New Keynesian Model," *NBER Macroeconomics Annual*, University of Chicago Press, vol. 26(1), pages 329 - 360.
- Gilboa, I., A. Postlewaite, L. Samuelson, and D. Schmeidler (2014), "Economic Models as Analogies", *Economic Journal*, 121: 513–533.
- Greenspan, A. (2013), *The Map and the Territory: Risk, Human Nature, and the Future of Forecasting*, New York, NY: The Penguin Press.
- Greenwald, B. and J. E. Stiglitz (1986), "Externalities in Economies with Imperfect Information and Incomplete Markets", *The Quarterly Journal of Economics*, 101(2), pp. 229-264.
- Hicks, J. (1983). 'A Discipline but Not a Science', in *CHECK Classics and Moderns: Collected Essays in Economic Theory*, 3, Oxford, Basil Blackwell.
- Kiyotaki, N. and J. Moore (1997), "Credit Cycles", *Journal of Political Economy*, 105(2), pp. 211-248.
- Kiyotaki, N. and J. Moore (2008) "Liquidity and Business Cycles", manuscript, Princeton University.
- Koo, R. C. (2008), *The Holy Grail of Macroeconomics*, Singapore: John Wiley

- Korinek, A. (2011), "Systemic Risk-Taking: Amplification Effects, Externalities, and Regulatory Responses", European Central Bank (ECB) Working Paper Series No 1345.
- Krugman, P. (2011), "Mr Keynes and the moderns", VoxEU, June 21, see: <http://www.voxeu.org/article/mr-keynes-and-moderns> (accessed 3rd July 2014).
- Leijonhufvud, A. (1981), "Effective Demand Failure" Chapter Six of his *Information and Coordination: Essays in Macroeconomic Theory*. Oxford: Oxford University Press
- Lucas, R. E. (2013), "The Death of Keynesian Economics", Chapter 21 in: *Collected Papers on Monetary Theory*, Edited by M. Gillman, London: Harvard University Press, pp. 500-513.
- Luchinger, R. (ed.) (2007) *Die Zwölf Wichtigsten Ökonomen der Welt*. Zurich: Orell Fussli Verlag.
- Mankiw N. G. and D. Romer, eds., (1991), *New Keynesian Economics*. Vol. 1: Imperfect competition and sticky prices. Vol. 2: Coordination Failures and Real Rigidities. Cambridge MA: MIT Press.
- Miller, M. (2011), "Macroeconomics: a discipline not a science", *The Manchester School*, 79(S2), pp. 1-24.
- Miller, M. (2009), "Black holes and financial crises: Is there any escape?", VoxEU, October 03.
- Miller, M. and J. E. Stiglitz (2010), "Leverage and Asset Bubbles: Averting Armageddon with Chapter 11?", *Economic Journal*, 120(544), pp. 500-518.
- Miller, M. and L. Zhang (2014) 'To exit the Great Recession, central banks must adapt their policies and models', VoxEU, September 10.
- Minsky, H. (1975), *Stabilizing an unstable economy*, New Haven CO: Yale University Press.
- Myerson, R. B., 1984, "Two-Person Bargaining Problems with Incomplete Information", *Econometrica*, Vol. 52, No. 2, Mar., 461-488.
- Myerson, R. B. & Satterthwaite, M. A., 1983. "Efficient mechanisms for bilateral trading," *Journal of Economic Theory*, 29(2), pages 265-281.
- Piketty, T., 2014. *Capital in the Twenty-first Century*, The Belknap Press of Harvard University Press: Cambridge, Massachusetts.
- Ramsey, F. (1928), "A Mathematical Theory of Saving", *Economic Journal*, 38(152), pp. 543-559; re-printed, with an appreciation by O.P. Attanasio, in 125(583), pp. 278-294.
- Shin, H. S. (2010), *Risk and Liquidity*, New York: Oxford University Press.
- Schoenmaker, Dirk, (2015), *Macroprudentialism*, A VoxEU.org eBook, London:CEPR Press.
- Skidelsky, R. (2009), *Keynes: The Return of the Master*, New York: Public Affairs.
- Solow, R. (2010), Presentation on DSGE models to the U.S. House of Representatives Committee on Science and Technology on July 20, 2010. (Cited in Garcia, N. E. (2011) "DSGE models: a critique", *Economie Appliquée*, N°1, Jan-Mar.)
- Wiener, N. (1993) *Invention: the care and feeding of ideas*. Cambridge MA: MIT.
- Wieland, V. (2010), *The Science and Practice of Monetary Policy Today*, *The Deutsche Bank Prize in Financial Economics 2007*, Berlin: Springer Verlag Berlin Heidelberg.

Wolf, M., (2014), *The Shifts and the Shocks*, London: Allen Lane

Woodford, M. (2003), *Interest and Prices*. Princeton NJ: Princeton University Press.